IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Bilyalov, Renat
Appl. No.	:	10/658,114
Filed	:	September 8, 2003
For	:	PHOTOVOLTAIC DEVICE
Examiner	:	Trinh, Thanh Truc
Group Art Unit	:	1795

DECLARATION OF JEF POORTMANS, PH.D.

Dear Sir:

I, Dr. Jef Poortmans, declare as follows:

I am employed by Interuniversitair Microelektronica Centrum vzw, where I hold the position of Director Solar & Organic. I received my degree in electronic engineering from the Katholieke Universiteit of Leuven, Belgium, in 1985, and have since then been working in the semiconductor electronics field.. I received my Ph.D. degree at the same University in June 1993. I authored or co-authored nearly 350 papers that have been published in Conference Proceedings and technical journals. I have written 4 book articles. I am an inventor on more than 10 patents and patent applications.

I am familiar with the present application (on which I am a co-inventor), its prosecution history, and the art of record in the application. It is my understanding that Claims 1, 3-25, 37-42, 45-47, and 50 have been rejected under 35 U.S.C. §103(a) as obvious over Yamada et al. (U.S. 5,331,180) in view of Berger et al. ("Porosity superlattices: new class of Si heterostructure"); Claim 26 has been rejected under 35 U.S.C. §103(a) as obvious over Yamada et al. in view of Berger et al. and further in view of Suzuki et al. ("U.S. 5,644,156"); and Claims 48 and 49 have been rejected under 35 U.S.C. §103(a) as obvious over Yamada et al. in view of Berger et al. and further in view of U.S. 6,399,177 ("Fonash et al.").

The devices of Yamada et al., Berger et al., Suzuki et al., and Fonash et al. are light emissive devices, in contrast to the photovoltaic devices as recited in the claims. A photovoltaic device converts light into electricity, whereas a light emissive device converts an electrical signal

into emitted light. The function of a porous layer in both types of devices (photovoltaic versus photoemissive) is different, therefore the thickness of the porous layer in both types of devices is substantially different – the thickness of the porous layer is not just a matter of design choice. With respect to light emitting devices, it is known that silicon has an indirect band gap and is generally not considered to be suitable for use in light emitting devices. Therefore porous silicon is used as a layer for converting an electrical signal into light. For example, in Yamada et al. (see col. 8, lines 18 to 35) it is explained that a radiative mechanism is obtained through the use of porous fine wires. When a voltage is applied over the LED structure, avalanche breakdown occurs within the quantum wire cluster (i.e., the porous silicon) to generate electron-hole pairs; through recombination of the electron-hole pairs, visible light is radiated from the quantum wires. Because the light generation occurs in the porous layer, a relatively thick porous layer, namely, a layer having a thicknes of 100 to 1000 nm, is preferred.

Contrary to assertions in the Office Action, it is not correct to say that Berger et al. teaches a porous layer having a thickness of 20 nm. Instead, Berger et al. teaches the use of superlattices as a filter which can be used to narrow the broad luminescence spectrum of porous silicon. This narrowing of the spectrum would not be obtained with a porous layer having a thickness as in the device of the pending claims, but can only be obtained only with a much thicker superlattice comprising a periodic porosity variation.

I and my co-inventors' device is a photovoltaic device, e.g., a HIT (Heterojunction with Intrinsic Thin-layer) cell. The device as claimed has a second layer comprising a crystalline semiconductor material, a first layer comprising an amorphous silicon semiconductor material which forms a heterojunction with the second layer, and a third layer comprising a porous, non-doped (intrinsic) semiconductor material. This is the structure of a HIT (Heterojunction with Intrinsic Thin layer) cell. As discussed in Example 1 of our application as filed, a comparative example, a photovoltaic cell structure wherein the third layer is an intrinsic amorphous silicon layer is known in the art. It is known in the art that the incorporation of such an intrinsic amorphous silicon layer improves the properties of the heterojunction via reduction of carrier recombination. In our device as presently claimed, replacing the intrinsic amorphous layer by a porous layer offers superior properties and advantages when compared to prior art devices. One advantage is that the porous layer also acts as a barrier layer (e.g., against indium diffusion). The

porous layer also exhibits less light absorption than an intrinsic amorphous silicon layer. As illustrated in Figures 3 to 6, of our application as filed, using a porous layer instead of an intrinsic amorphous silicon layer results in superior photovoltaic cell properties, especially for very thin porous layers (e.g., a 24 nm or 26 nm thin porous layer exhibits superior properties, but the results for a 16 nm thin porous layer are even better still). Excellent results are obtained for porous Si layers with a very low porosity of 15-20% and the thickness in the range of 5-10 nm as measured by spectroscopic ellipsometry. There is no teaching or suggestion in any of the cited art as to the recited thickness of a porous layer in a photoconductive (electricity-generating) device as claimed. To the contrary, one would select a thick porous layer based on the teachings of the cited art, because thick porous layers are desirable in photoemissive devices. Accordingly, layer thickness is not just a matter of design choice; it is key parameter that determines photoconductive properties of the device.

I declare that all statements made herein are true, and that all statements made upon information and belief are believed to be true, and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that willful, false statements may jeopardize the validity of the application, or any patent issuing thereon.

Dated: 11-9-2009

Jef Poortmans

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